wound having been closed with a pad of lint, this was firmly retained by plaster and bandage. Then the limb was brought down to a straight position, and, the section-ends of the femur being in apposition, although with some angular inclination forwards, a long external interrupted splint was applied. The pad was not removed for ten days, when the wound had healed without any suppuration, the lint only sticking to the puncture. At the end of six weeks, the boy was able to get about the ward on crutches, the bone having firmly united; and in three weeks more, the limb could bear weight with equal balance on the other, and he was discharged from the hospital. A few days ago, after a year's result, he could walk well, with a high heel and thick sole to his boot.

ANTISEPTIC OSTEOTOMY IN GENU VALGUM AND ANTERIOR TIBIAL CURVES:

WITH A FEW REMARKS ON THE PATHOLOGY OF KNOCK-KNEE.*

By WILLIAM MACEWEN, M.D.,

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THERE are several points, in addition to those already published, concerning the operation which I have advanced for the relief of genu valgum by transverse incision through the femoral diaphyses, which are considered worthy of attention.

A. *Direction of the Osseous Incision: Avoid encroaching on the External Condyle.*—Some surgeons have expressed a difficulty experienced by them, in endeavouring to carry out my operation by division of the femoral diaphyses, first of all, while dividing the bone, and, secondly, while bending or snapping the outer layer, after they considered it sufficiently divided. Not only so; but, as a result in some cases, a projection, which could be felt under the skin and sometimes seen, appeared on the anterior external aspect of the limb. It is more than probable that in these cases a mistake has been made in beginning the incision too low, and in then cutting transversely to the axis of the body, and so landing the instrument in the massive external condyle; where the operator, especially if it be his first case, and that case occurring in the adult, is apt, while cutting, to lose his bearings, and finds the bone difficult to bend or snap. Besides the disadvantages which the surgeon experiences, the upper external anterior extremity is apt to project and appear unseemly, and the transverse division of the external condyle may interfere with the origin of the plantaris, the outer head of the gastrocnemius, and even the popliteus muscles. A little consideration of the relation of parts will be sufficient to enable this error to be avoided.

In the normal limb, a line drawn from the spine for the insertion of the adductor magnus tendon, transversely to the axis of the limb, would in most cases pass into the upper part of the external condyle; but, in genu valgum, the whole internal condyle is lowered, so that a line drawn at right angles to the limb's axis, at the level of the spine, would pass into the middle of the external condyle, and would also encroach on the anterior femoral articular surface. In fact, in some very aggravated cases of genu valgum, a line drawn from the spine for the insertion of the adductor magnus tendon transversely to the body would land very near the lower portion of the external condyle. This mistake may be avoided in one of two ways: either by commencing in the adult an inch above the spine for the insertion of the adductor magnus tendon, and cutting parallel to the condyles; or by taking the guides formerly given by me, cutting transversely across the femur on a level with a line drawn half an inch above the upper margin of the patella when the limb is in the extended position; or by taking a line drawn transversely to the limb half an inch (in the adult) above the external condyle. By keeping these points in view, and operating according to the instructions given in the BRITISH MEDICAL JOURNAL for May 3rd, 1879, this will be found one of the easiest surgical operations.

B. *The Exact Seat of the Incision in the Soft Parts, so as to avoid Bleeding.*—Regarding bleeding from the seat of incision in the soft parts, I stated that I had not found it necessary in the last thirty cases to apply a ligature; the same result has followed twenty cases occurring since that time, making in all fifty cases in which no ligature has been applied in the femoral incision for genu valgum. Some surgeons have, however, told me that they have had arterial bleeding necessitating the application of a ligature or ligatures. In such cases, I would be inclined to think that the incision had not been made in the position pointed out, that is to say, at the point where the two following lines meet, a line drawn transversely from the upper border of the patella when the limb is in the extended position, and a line drawn longitudi-

nally about half an inch anterior to the spine for the insertion of the adductor magnus tendon. That position is below and anterior to the anastomotic magna, and above the superior internal articular; and, by making an incision about half an inch in length directly to the bone at this point, it is impossible to touch any normal distribution of these branches. Any bleeding which might occur from superficial veins may be completely arrested by pressure of a sponge for a few minutes.

C. *The Transverse Extent of the Osseous Incision.*—The extent of the femoral osteotomy depends upon the nature of the case. When the bones are soft and yielding, as is generally the case up to fifteen or sixteen years, and typically so in plump girls at that age, if the bone be divided for fully the internal two-thirds, the remainder may be easily bent round so as to form a green-stick fracture. In this case, the bending ought to be performed gradually, and not with a quick jerk. On the other hand, when the bones are hard and brittle, when the feeling imparted to the osteotome is similar to that conveyed on cutting old dried bone, and when even by a smart blow with the mallet little impression is made—these are cases where the incision ought to pass to the dense shell of bone on the outer side, leaving it alone to be snapped. This state of bone is sometimes met with in the adult—twenty years and upwards; especially in those who have been rickety, the bones are found at that age to contain a large proportion of earthy matter and to be brittle. The individuals are thin and have a scraggy peculiar look, which in a short time the surgeon begins to recognise. In these cases everything ought to be done by cutting with the osteotome, and as little as possible left to be snapped. It is also specially necessary to avoid using much force in snapping. It has been stated that some surgeons place their knee as a fulcrum on the joint, and so break the bone; that others seek the aid of several assistants in snapping the bone. The employment of such force is not only quite unnecessary, but in the class of cases at present under notice might lead to very serious comminution and bad after-results. When the surgeon—placing his left hand over the wound, takes the right lower limb in his right hand, then using the left as a fulcrum, and the right as a lever—finds that he cannot readily cause the bone to yield, he may be sure that he has not sufficiently cut the bone all round; he ought to desist from attempting to snap the bone, reintroduce his osteotome, and find the point that requires division. Most often, the posterior border has some little point that requires division, when a very few touches with the osteotome will remove the obstacle to easy bending or snapping of the bone. After a little experience, the reintroduction of the instrument is seldom required.

D. *Does the Femoral Incision impair or arrest the Growth of the Bone?*—There has been a fear expressed that this femoral incision might in some way encroach on the epiphysis, and impair or prevent the ultimate growth of the bone. It must be remembered that the incision, as proposed by me, is through the diaphysis about an inch above the epiphysis, so that the latter is never interfered with. As a matter of fact, experience lends no countenance to that fear; those first operated on, three years ago, having continued to grow in strength and height, their limbs developing proportionately.

It must also be remembered that the operation, as an immediate result, increases the height of the patient. One man, operated on recently, rose from his bed four weeks afterwards three inches higher than when he lay down. Thus the operation not only rectifies a deformity, but adds to the patient's height.

E. *A very few Remarks on the Pathology of Genu Valgum.*—Having had over one hundred cases of genu valgum under observation, the general impression which their pathological condition conveyed pointed to certain conclusions; but, before formulating these, it was considered advisable to take more minute measurements than hitherto, and to arrange them according to a definite plan. At present, there have been over thirty cases thus minutely measured; and, though I intend reserving the consideration of these in detail for the future, it may not be inconvenient to state here several particulars which bear on the practical aspect of the question.

In every case, the articular surface of the internal condyle has been found at an abnormally lower level than the external. With this exception, there seems to be no constant invariable or pathognomonic condition of knock-knee. In the majority of instances, an alteration has been found in the plane of the condyles; so that the whole internal condyle is lowered, and the external condyle is elevated. In a number of these cases, this seems to be due to the inward curve of the lower third of the femur, and a twisting outwards of the condyles, as if one had taken the limb while still soft, and, putting one hand above the middle of the thigh, and the other on the condyles, and placing the operator's knee on the outside of the lower third, had thus bent the limb. At other times, this lowering of the internal condyle seems to be due to an increase of the lower internal end of the diaphyses, as Mikulicz has pointed

* Read in the Section of Surgery at the Annual Meeting of the British Medical Association in Cork, August 1879.

out. But where this is the sole cause, the deformity is not aggravated. In some rickety cases, besides the conditions producing the knock-knee there are other deformities, such as a forward bend of the lower third of the femur, but much more frequently a flattening and inward inclination of the internal condyle. Regarding the intrinsic lengthening of the internal condyle, there were cases where there was no increase in the relative length of the internal to the external condyle; and there was actually one instance where there was an abnormality in the opposite direction, the internal condyle being the same size as the external. In such cases, some other factor or factors accounted for the deformity. But there are also a considerable number of cases where the internal condyle was intrinsically longer than the external. These measurements were taken by callipers, and not by tape. This latter fact, regarding the lengthening of the condyle, is opposed to some views recently advanced. The lengthening of the internal condyle differed in degree in various cases: in some few, it seemed to be the chief element in the knock-knee; but in the majority it only formed one of the factors.

Besides the state of the femur, there was found in some cases a slight, and in a very few cases a marked, tibial elongation of the proximal internal aspect of the shaft. But these elongations of the tibiae were very slight as compared to the femoral deviations. The most marked tibial deformity consists in the inward development of the shaft and flattening of the inner portion from before backward, ending in spines or buttresses on the inner side.

As a rule, there are generally two or three factors in the formation of knock-knee.

F. Observations on the Tibial Incision in Knock-Knee.—It has just been stated, under the brief remarks on pathology, that the tibia is sometimes involved; the question naturally arises, whether the tibia ought to be divided, in addition to the femur, and, if so, in what proportion of cases?

In the majority of instances, the tibia is not involved to an extent demanding the practical consideration of the surgeon. Even in genu valgum adolescentum, the tibia is not invariably involved; and in many instances, even when involved, it is to such a slight extent that the femoral incision alone is sufficient to enable the limb to be brought into a straight line, without producing one deviation for another, as has been remarked. Not only so, but even in these cases where the tibia is involved to a marked extent, in the production of knock-knee, the limb may be brought, by the femoral incision alone, sufficiently straight to enable the weight of the body to fall on a line drawn through the knee and the middle of the ankle-joint—thus making a limb which, as far as utility is concerned, is as good as when the tibia is cut as well as the femur. When such a limb is exposed, the flattening of the tibial head and the spine, which project on the internal surface, appear prominent, and make a lower limb which when nude is not symmetrical, but when clothed looks quite straight. In one of the most aggravated cases of genu valgum which has come under my notice, occurring in an adult of twenty-one years, the limb was brought into a straight line by femoral osteotomy, the tibia not being touched. The tibia, having the flattened head and well-marked buttresses on the inner side, is still to that extent deformed, though the genu valgum is obliterated. But even the addition of a simple tibial osteotomy would not do away with this deformity; it might assist, though it would not entirely efface it.

Keeping these reservations in mind, I have to state that the tibial incision, in cases of very aggravated genu valgum, not only is justifiable, but conduces to the ultimate result, imparting greater symmetry to the limb. In operating on the tibia, the form of the section of the bone just below the spine ought to be kept in view, though to the outline of the normal section a considerable flattening and thickening of the bone on the inner side ought to be added. In dividing the tibia, after having first operated on the femoral expanded diaphyses, one finds, as a rule, a very great contrast in the density of the bones, the tibia being much harder and more difficult to cut. The manner in which I perform this part of the operation is as follows. An incision in the soft parts, sufficient to admit the osteotome, is made at a point on the inner side of the tibial surface, midway between the anterior and posterior border and opposite the lower border of the tibial tuberosity. The tibia is then divided from within outwards, commencing from the posterior border, and raising the osteotome gradually up until it comes into contact with the anterior surface at the lower portion of the tubercle, which is by far the most dense portion. The osteotome ought then to be directed from before backward, the tissues to the outside being gently retracted meanwhile; and so this dense part is divided. The femoral and tibial incisions I have always performed at the same time.

The fibula I have never seen the necessity of touching, either by causing a simple fracture or by cutting, in any case of genu valgum. I have, therefore, never seen the necessity of performing Mr. Barwell's operation of division of this bone. On several occasions, I have

divided the only tendinous structure which can prevent the perfect straightening of the limb after the femoral incision, the tendon of the biceps, as it is inserted into the fibular head. These were aggravated cases, where the tendon stood very prominently out, and in these I derived advantage from its division; but this division is seldom necessary.

In one very marked case, where the deformity was equal in both limbs, I divided the tibia in the one limb along with the femoral incision, and in the other I performed only the femoral osteotomy and divided the biceps tendon; and the result of the latter operation was the better of the two, though both were good.

G. Observations on Division of the Femur from the External Surface in Genu Valgum.—Some surgeons have in cases of knock-knee divided the femur on the outside of the limb, and they advocate this method in genu valgum. Though no mechanist would adopt such a course to rectify this deformity, yet the surgeon, relying on nature, believes that in her bounty she will make up for his shortcomings. I have great faith in the reparative powers of nature, yet, not considering them illimitable, do not care to overtax her, or to become a mendicant on her bounty, especially when there is no occasion for it. I cannot see a single reason why the external aspect ought to be chosen in genu valgum, and it has several grave disadvantages.

First, the form of a section of the femur, just above the condyles, may be roughly stated to be conical, the base or broad extremity being toward the outside; consequently, the surgeon cuts from the base towards the apex, and as he cuts the anterior and posterior borders, unless he exercises great care, he is apt to allow one border of the instrument to escape and to divide the soft tissues simultaneously with the bone. The femoral artery is also in this way more liable to be cut. On the other hand, with the internal division, one cuts from an apex toward an osseous base; the further the instrument enters, the deeper it is embedded in the bone, and the further are its borders removed from the soft tissues. Second, in passing the osteotome or chisel through the femur from the outside, a wedge opening is made of the thickness of the instrument, and to that extent the outside of the limb is shortened, instead of being lengthened. That is to say, the outside of the limb is already too short, and the operator intending to rectify this shortening commences by making it still shorter. When the operation is performed on the inner side, the side which is abnormally long is shortened. Thirdly, when the incision is made from the outside of the limb, the entire deformity is rectified from that side, and consequently a large gap is left to be filled by new tissue; and that, too, with the periosteum divided transversely, and in no way bridging the interspace, so that the new bone must be supplied from the widely separated osseous extremities. In dividing from the inside, the gap left by the graduated osteotome is immediately filled up by bringing the limb into the straight position, the cut and separated surfaces of bone and periosteum being placed in immediate contact. In aggravated cases, when the deformity is very great and the gap made by the graduated osteotome is not quite sufficient to rectify the deformity, the limb is brought into the straight position by leaving a slight gap on the outside, covered, however, by periosteum, either completely or in shreds; or, if the bone be young (fifteen to seventeen years of age), there may be, correctly speaking, no gap on the outside, but a mere stretching of the outer layers of bone, the osseous fibres still interdigitating somewhat after the fashion of a green-stick fracture. In aggravated cases, therefore, in cutting from the inner side, both sides of the bone are made to contribute to the rectification of the deformity; the inner by being shortened, the outer by being stretched or lengthened. Fourthly, though suppuration would rarely take place, still, if it did so, it would not readily find vent, owing to the manner in which the tissues on the outside of the thigh are bound down by the fascia lata. I have been told of two cases where this occurred after cutting from the outside, and where it gave rise to very considerable trouble, counteropenings behind having to be made for the exit of discharge. One would expect that those who operate from the outside of the femur would also advise the tibial incision; the latter so far making up for the shortening made on the femur, and also preventing the formation of too large a gap on the outside.

It has been said that operating on the outer side of the femur has resulted in straight useful limbs, and that fact has been placed against my criticism. I in no way doubt that fact, but cannot see that it is a sufficient reason for preferring that mode of operating. A straight limb resulted in a patient who had a bad knock-knee, and who came under my observation as the recipient of an accident, a cart-wheel having run over the deformed leg. Yet, I presume no one would be inclined to adopt that method of straightening knock-knee, even supposing the result in that case was good.

H. Anterior Tibial Curves, and their Treatment.—A considerable number of persons suffer from anterior curves in the tibia. Sometimes these involve the whole tibia, from the foot of the tubercle to the ankle,

forming a bow, with the tendo Achillis stretching along its base like a bow-string. More often the lower two-thirds are implicated, and sometimes the lower third is alone affected. In most of these cases, the tibia is elongated from before backwards, and flattened laterally; the fibula generally participating in this part of the deformity. In these cases, the deformity, when slight, may be corrected by a simple osteotomy; that is to say, the division of the bone from before backward, at the most prominent part of the convexity, by an osteotome. But, when they are more pronounced, a series of osteotomies, or the removal of a wedge, is necessary to rectify them. Of the two methods, I am inclined (when a single simple osteotomy is not sufficient) to remove a wedge, as being on the whole the most simple and satisfactory. Now, many have asked an easy method of ascertaining the size of the wedge to be removed, without going into mathematical calculations. One of the easiest methods of ascertaining the size of the wedge to be removed is by turning the limb on its side, and taking a tracing of the anterior edge of the tibia. Next, measuring the breadth of the tibia, from before backward at the most prominent part of the convexity, and drawing a second line parallel to the former, corresponding to the thickness measured, then cut this shape out. After this has been done, fold the paper, at the most prominent part of the convexity, wedge-fashion, with its base anteriorly, until the pattern has become straight. The base of the wedge will then represent the size of the wedge to be removed. Having ascertained this, it is convenient to have it marked by measuring it with a pair of callipers, keeping their blades fixed at the distance measured, so that they may be applied to the bone when necessary. An incision sufficient to admit the instrument is all that is necessary, as the skin will slide upwards and downwards to suit. A chisel (not an osteotome) is used. It ought to have a keen cutting edge, with little bevel. It is convenient first to remove a wedge smaller than is required; and then to remove from either side one or two shavings up to the desired extent. In this way, opportunity is given for making the incision on each side perfectly smooth. In cutting out the wedge, the periosteum on either side can be preserved, and, if so, it gives a surety that the border of the chisel has not injured any of the soft structures. After removing the wedge, and seeing that no fragments of bone remain in the opening, the fibula may be attended to. In many cases, a simple fracture may be made; but in some, especially when it is flattened and perhaps elastic, this is not so easy; and it is better to make a subcutaneous osteotomy with the osteotome; after which the limb will become straight by bringing the two anterior tibial cut surfaces into apposition. Some have spoken of dividing the tendo Achillis in such cases; and it is possible that it facilitates the rectification of the osseous deformity, when it is present to a marked extent. In the majority of cases, I have not divided the tendo Achillis, and have found that, after the first two or three days, there is no trouble with it, the foot being fixed to the foot-piece of the splint.

ON GENU VALGUM: WITH SOME REMARKS ON OPERATIONS FOR ITS REMOVAL.*

By B. E. BRODHURST, F.R.C.S.,
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GENU VALGUM is an affection of so frequent occurrence that it has lately attracted a good deal of attention, and various modes of treatment have been suggested. Some rely on mechanical support for its removal; while, again, we have various operations, namely, such as have been described and practised by Dr. Ogston, Dr. Macewen, Mr. Barwell, Mr. Reeves, and others; among which I will especially mention one which I have several times performed, and to which I have on another occasion directed attention.

But, before alluding more directly to this operation, I will answer the question: What is genu valgum? Genu valgum is produced by the yielding of the internal lateral ligament of the knee-joint, and it is usually preceded by flat foot. When first observed, it may be removed simply by taking the weight of the body off the feet, and later slight lateral pressure will produce the same effect. After a short time, however, the whole lower epiphysis of the femur becomes oblique, and at length the shaft of the bone becomes more or less seriously involved, as well as the tibia itself. The motions of flexion and extension become somewhat restrained, the leg and thigh-bones being somewhat locked, in consequence of and in proportion to the obliquity of the femur. In an early stage, the recumbent position, with perhaps some slight lateral support, is sufficient to overcome deformity; but, when deformity is considerable

and has lasted several years, it is perhaps yet a question how this obliquity is most readily, and with the least material damage to the parts concerned, to be removed.

That there is such an affection as a prolongation downwards of the inner condyle I do not deny; but I contend that it is of great rarity; and, if the malady be not confined to the inner condyle, but extend along the entire breadth of the epiphysis, and implicate the shaft of the femur as well as the tibia, to operate on the inner condyle alone is calculated to complicate rather than to remove the deformity.

There are cases in which Mr. Barwell's operation—namely, to divide the femur in part, and then to straighten the bone, and subsequently and at some interval of time, to divide the tibia and the fibula, and thus to bring the limb into a straight line—may be the best to be done; but the cases are rare where the advantages to be derived would be considered sufficient compensation for such an operation. The instances are not frequent in which this operation is needed. But there are a large number of cases where osteotomy is not necessary, and where mechanical appliances are useless—cases where a certain amount of separation of the articular ends of the bones becomes necessary before the limb can be straightened. This may be gained by the division of the biceps tendon and the external lateral ligament, and, when it is tense, of the ilio-tibial band. When deformity is not very severe, the limb may be immediately placed in a straight position, and, being confined in a splint, may be so retained.

On June 15th, 1877, I operated on a youth, fifteen years of age, where the inner malleoli were eighteen inches apart and the patellæ were dislocated outwards. He left London in a fortnight with perfectly straight limbs, and in the course of six weeks he walked easily with supports. He continued to wear these supports for four months, and at the expiration of this time I advised that they should be discontinued. He has not since needed them. I saw the patient in June last, and found him straight, and without undue lateral motion of the knee, and able to take much exercise.

After considerable experience of this operation, I have never known any ill effects to arise from it, and have always had reason to be satisfied with the results.

ON OSTEOTOMY OF BOTH THIGH AND LEG FOR GENU VALGUM.*

By [RICHARD] BARWELL, F.R.C.S. Eng.,
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IT is not my intention to detain the members of this Section with details concerning the different forms of operation for knock-knee, nor to criticise the methods proposed and adopted by other surgeons; my object is simply to give my reasons for operating by dividing the bones right across, and in most instances the bones both of the thigh and leg.

Firstly, however, it should be said that I believe it impossible to cure a well marked case of knock-knee by instruments, unless the bones be very unusually soft; and that, even were it possible, the long continuance and irksomeness of the treatment render it an undesirable method. It is worse than useless to attempt cure of a deformity which originates in obliquity of the bones by division of ligaments; a limb thus treated could only be put into a straight position by forcing and keeping the outer part of the joint-surfaces asunder. It need hardly be said that no articulation could, when thus distraught, perform its function.† Perhaps, too, a few words as to the advisability or the reverse of operations at an early age should be added. I would gladly avoid all such undertakings previous to the seventh year, but occasionally they are almost forced upon me; yet I absolutely refuse to operate if the bones bend or seem elastic to manual pressure. When, on the contrary, the bones are absolutely unyielding, I have frequently performed osteotomy with permanently good result. (Tracing shewn.) It must, too, be remembered, that if the deformity be unequal, if one limb be more distorted than the other, or if there be genu valgum on the one side, varum on the other, an oblique position (laterally) of the pelvis is produced, which must result in scoliosis; and a rickety lateral curvature of the spine is rarely, if ever, curable; hence, early osteotomy, if the bones be hard, is frequently desirable; and when the first, the softening, stage of rachitis has ceased, the bones become exceedingly hard, almost stony.

The direction which the surgeon chooses for division of the bones will depend upon the notion formed by him of the deformity. Seventeen years ago, I had several opportunities of studying the real cause of

* Read in the Section of Surgery at the Annual Meeting of the British Medical Association in Cork, August 1879.

† This view was forcibly proved, I believe, to all present at a meeting of the Clinical Society in June, when a case thus treated was shown.